



## AS13704D Quad Operational Transconductance Amplifiers (OTA) with linearizing diodes

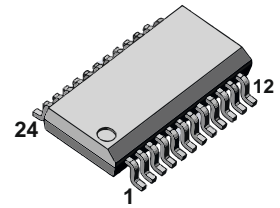
### Features

- $g_m$  adjustable over 6 decades
- excellent  $g_m$  linearity
- excellent matching between amplifiers
- linearizing diodes for reduced output distortion
- high output SNR
- LM13700 functional replacement (without output buffers)

### Applications

- current-controlled amplifiers
- stereo audio amplifiers
- current-controlled impedances
- current-controlled filters
- current-controlled oscillators
- multiplexers
- timers
- S&H circuits

### AS13704 D



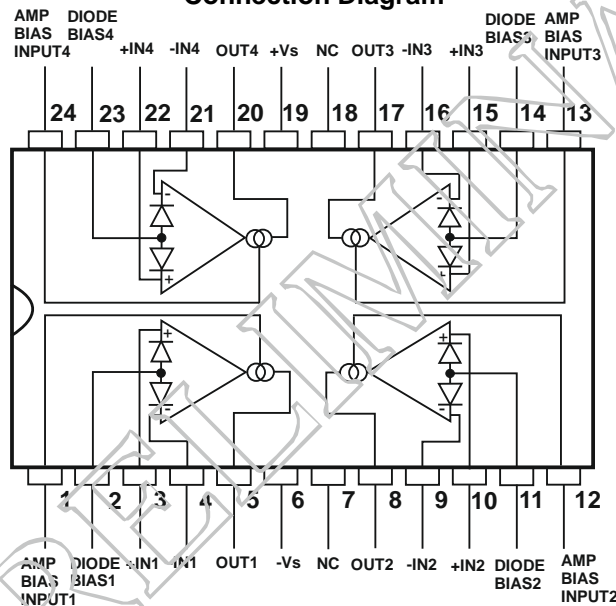
SSOP24, 150mil, 0.635 mm

### General Description

The AS13704D consists of four current-controlled transconductance amplifiers OTA, each with differential inputs and a push-pull output. All amplifiers share common supplies, but operate independently. Linearizing diodes are provided at the inputs to reduce distortion and allow higher input levels. The result is a 10-dB signal-to-noise improvement referenced to 0.5 percent THD.

PART NUMBER	PACKAGE	BODY SIZE (NOM)
AS13704D	SSOP 24	150 mil, 0.635 mm pitch

### Connection Diagram

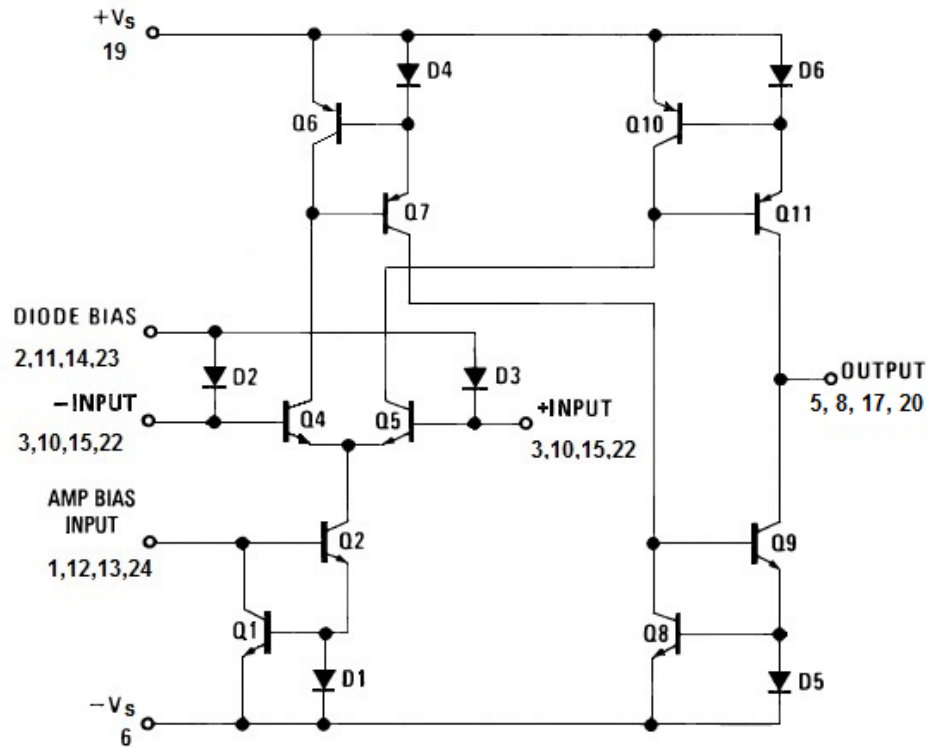


### Pin Functions

Name	Pin Number	Description
Amp bias input 1,2,3,4	1, 12, 13, 24	Current bias input
Diode bias 1,2,3,4	2, 11, 14, 23	Linearizing diode bias input
+IN 1,2,3,4	3, 10, 15, 22	Positive input
- IN 1,2,3,4	4, 9, 16, 21	Negative input
Output 1,2,3,4	5, 8, 17, 20	Output
+Vs	19	Positive power supply
-Vs	6	Negative power supply
NC	7, 18	Not connected



**Functional Block Diagram - One Operational Transconductance Amplifier**



**Specifications**

**Absolute Maximum Ratings**

over operating free-air temperature range (unless otherwise noted)<sup>(1)</sup>

	MIN	MAX	UNIT
Supply voltage		36 V <sub>DC</sub> or ±18	V
DC input voltage	+Vs	-Vs	V
Differential input voltage		±5	V
Diode bias current (I <sub>D</sub> )		2	mA
Amplifier bias current (I <sub>ABC</sub> )		2	mA
Power dissipation <sup>(2)</sup> T <sub>A</sub> = 25°C - AS13704D		400	mW
Output short circuit duration		Continuous	
Storage temperature, T <sub>stg</sub>	-65	150	°C

- (1) Stresses beyond those listed under *Absolute Maximum Ratings* may cause permanent damage to the device. These are stress ratings only, which do not imply functional operation of the device at these or any other conditions beyond those indicated under *Recommended Operating Conditions*. Exposure to absolute-maximum-rated conditions for extended periods may affect device reliability.
- (2) For operation at ambient temperatures above 25°C, the device must be derated based on a 150°C maximum junction temperature and a thermal resistance, junction to ambient, as follows: AS13704D, 90°C/W.

**Recommended Operating Conditions**

over operating free-air temperature range (unless otherwise noted)

	MIN	MAX	UNIT
+Vs (single-supply configuration)	9.5	32	V
+Vs (dual-supply configuration)	4.75	16	V
- Vs (dual-supply configuration)	-16	-4.75	V
Operating temperature, T <sub>A</sub>	0	70	°C

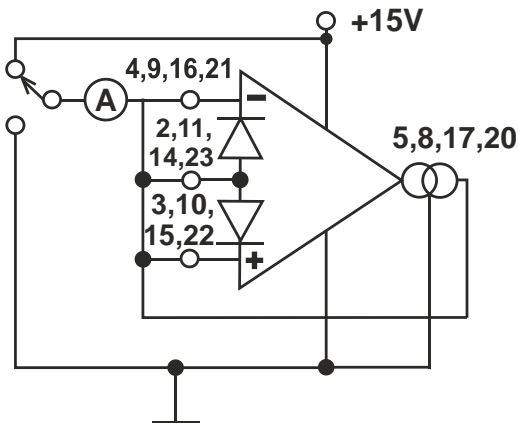


**Electrical Characteristics**

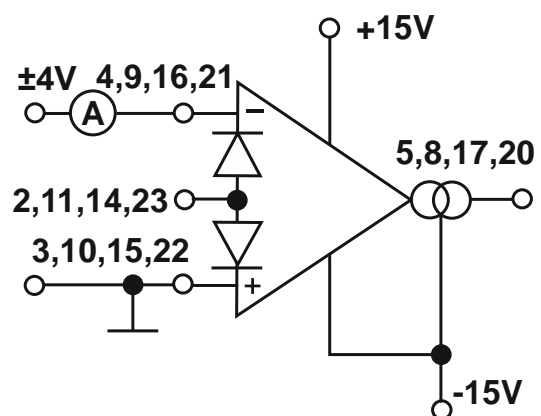
These specifications apply for  $V_s = \pm 15\text{ V}$ ,  $T_A = 25^\circ\text{C}$ , amplifier bias current ( $I_{ABC} = 500\ \mu\text{A}$ , pins 2, 11, 14, 23 open unless otherwise specified. The outputs are open.

PARAMETER	TEST CONDITIONS	MIN	TYP	MAX	UNIT
Input offset voltage ( $V_{OS}$ )	Over specified temperature range		0,5	4	mV
	$I_{ABC} = 5\ \mu\text{A}$		0,5	2	
$V_{OS}$ including diodes ( $V_{OS(DIO)}$ )	Diode bias current ( $I_D$ ) = 500 $\mu\text{A}$		0,8	3	mV
Input offset change ( $V_{OS(CH)}$ )	$5\ \mu\text{A} \leq I_{ABC} \leq 500\ \mu\text{A}$		0	1	mV
Input offset current ( $I_{OI}$ )			0	0,2	$\mu\text{A}$
Input bias current ( $I_I$ )			0,9	1,5	$\mu\text{A}$
	Over specified temperature range		1	8	
Forward transconductance ( $g_m$ )	$I_{ABC} = 500\ \mu\text{A}$	7700	8500	9100	$\mu\text{S}$
	Over specified temperature range	5400			
$g_m$ tracking			0,3		dB
Peak output current	$R_L = 0, I_{ABC} = 5\ \mu\text{A}$		4,7		$\mu\text{A}$
	$R_L = 0, I_{ABC} = 500\ \mu\text{A}$	400	450	510	
	$R_L = 0$ , Over specified temp range	300			
Supply current	$I_{ABC} = 500\ \mu\text{A}$ , all channels		6		mA
CMRR		80	100		dB
Common-mode range		$\pm 12$	$\pm 13$		V
Crosstalk	Referred to input(1) 20 Hz < f < 20 kHz		100		dB
Differential input current ( $I_{DIC}$ )	$I_{ABC} = 0$ , input = $\pm 4\text{ V}$		5.4	16	nA
Leakage current ( $I_{LC}$ )	$I_{ABC} = 0$ (refer to test circuit)		0.2	100	nA
Input resistance		10	26		k $\Omega$
Open-loop bandwidth			2		MHz
Slew rate	Unity gain compensated		50		V/ $\mu\text{s}$
<b>PEAK OUTPUT VOLTAGE</b>					
Positive	$R_L = \infty, 5\ \mu\text{A} \leq I_{ABC} \leq 500\ \mu\text{A}$	13	13		V
Negative	$R_L = \infty, 5\ \mu\text{A} \leq I_{ABC} \leq 500\ \mu\text{A}$	-13,5	-13,2		V
<b><math>V_{OS}</math> SENSITIVITY</b>					
Positive	$\Delta V_{OS}/\Delta V^+$		20	150	$\mu\text{V}/\text{V}$
Negative	$\Delta V_{OS}/\Delta V^-$		20	150	$\mu\text{V}/\text{V}$
Noise Voltage (en)	$I_{ABC} = 1\ \text{mA}$	20Hz		300	pA/ $\sqrt{\text{Hz}}$
		1kHz		150	pA/ $\sqrt{\text{Hz}}$
		10kHz		150	pA/ $\sqrt{\text{Hz}}$
	$I_{ABC} = 100\ \mu\text{A}$	20Hz		24	pA/ $\sqrt{\text{Hz}}$
		1kHz		20	pA/ $\sqrt{\text{Hz}}$
		10kHz		20	pA/ $\sqrt{\text{Hz}}$

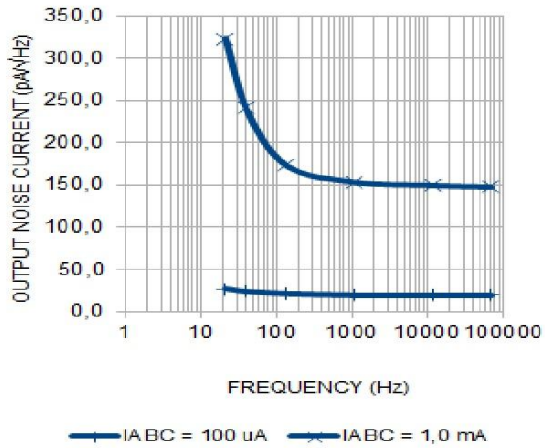
**Leakage Current Test Circuit**



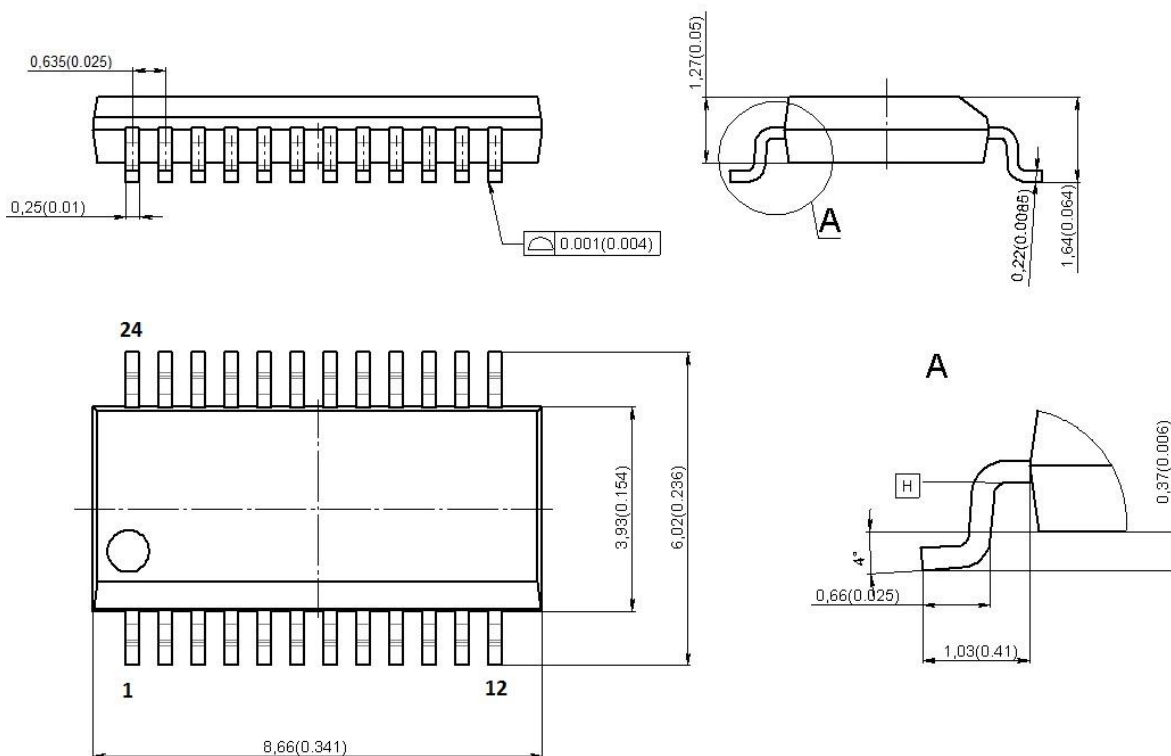
**Differential Input Current Test Circuit**



Output Noise Current vs Frequency



**Package Dimensions in millimeters (inches)**



**SSOP 24 (150mil)**

**Revision history**

Date	Revision	Changes
13-July-2018	<b>1</b>	Preliminary version 1
07-August-2018	<b>2</b>	Changes in Connection Diagram, Pin Functions, Features